In re Application of: Berthet et al.
Application No. 10/075,721
Response to Office Action of June 1, 2005

Listing of Claims

This listing of claims will replace all prior versions and listings of claims in the application.

Claim 1 (currently amended): ~~Method~~ A method of coding a digital data stream coded by spatio-temporal combinations in multiple transmission and reception, wherein ~~the~~ said method ~~consists~~ comprises, on the basis of an initial digital data stream:

[[-]]   ~~in~~ subjecting said initial digital data stream to an outer coding by means of a first code of specified rate, so as to generate a coded digital stream;

[[-]]   ~~in~~ subjecting said coded digital stream, subdivided into successive blocks, to a blockwise interleaving process so as to generate a coded and interleaved digital stream;

[[-]]   ~~in~~ subjecting said coded and interleaved digital stream to a demultiplexing, said coded and interleaved digital stream being thus subdivided into a given number [[v]] of elementary interleaved coded digital streams;

[[-]]   ~~in~~ subjecting each elementary interleaved coded digital stream to an inner coding by means of at least one second code of specified rate so as to generate a set of elementary digital streams, coded by spatio-temporal combinations;

[[-]]   ~~in~~ transmitting each elementary digital stream comprising ~~consisting of~~ symbols over a transmission channel by means of a distinct transmission antenna, the set of said transmission antennas forming a space-diversity array, so as to generate a set of transmitted elementary digital streams exhibiting spatial and temporal diversity, thereby making it possible, on reception, to perform a decoding of the digital data stream coded by spatio-temporal combinations and comprised ~~consisting~~ of said set of transmitted elementary digital streams, on the basis of a priori information representative of the spatial and temporal diversity.

Claim 2 (currently amended): ~~Method according to~~ The method of Claim 1, wherein said at least one second code making it possible to achieve said inner coding is a unique code of specified rate, applied to each elementary interleaved coded digital stream.

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Claim 3 (currently amended): ~~Method according to~~ The method of Claim 1, wherein said at least one second code making it possible to achieve said inner coding is a distinct code of specified rate, applied to one of the elementary interleaved coded digital streams.

Claim 4 (currently amended): ~~Method according to~~ The method of Claim 1, wherein said at least one second code making it possible to achieve said inner coding comprises ~~consists of~~ a code of the spatio-temporal trellis coded modulation type, each code being applied to each elementary interleaved coded digital stream so as to generate a plurality of streams of modulation symbols, each stream of modulation symbols transmitted over the transmission channel emanating from a distinct transmission antenna, the groups of distinct transmission antennas for each code of the spatio-temporal trellis coded modulation type forming a sub-array of space-diversity antennas.

Claim 5 (currently amended): ~~Method~~ The method of decoding a digital data stream coded by spatio-temporal combinations in multiple transmission and reception, ~~this~~ said coded digital data stream ~~consisting~~ comprising at least ~~of~~ a set of elementary digital streams obtained by a first outer coding of an initial digital data stream by means of a first code of specified rate, blockwise interleaving of the coded digital stream emanating from this first outer coding, temporal demultiplexing of the coded and interleaved digital stream obtained on a specified number [[v]] of demultiplexing pathways, this coded and interleaved digital stream being thus subdivided into one and the same number [[v]] of elementary coded and interleaved digital streams, subjecting each elementary coded and interleaved digital stream to a second inner coding by means of at least one second code of specified rate so as to generate said set of elementary digital streams, coded by spatio-temporal combinations, transmission of each elementary digital stream comprising ~~consisting of~~ symbols by means of a distinct transmission antenna, the set of the transmission antennas forming an array of said specified number of space-diversity transmission antennas, wherein said decoding method ~~consists~~ comprises:

[[-]] ~~in~~ receiving said digital data stream coded by spatio-temporal combinations which includes ~~and consisting of~~ said set of elementary digital streams transmitted over a transmission channel on a plurality of reception antennas, the number of said reception

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antennas being independent of the number [[v]] of transmission antennas and forming an array of space-diversity reception antennas so as to define a set of elementary streams of modulation symbols received;

[[-]]   in subjecting said set of elementary streams of modulation symbols received to an iterative process of equalization of the transmission channel and of joint decoding, by means of said second inner coding on the basis of an extrinsic information stream on the bits coded by the first outer code and interleaved and emanating from a decoding on the basis of said outer code, said extrinsic information stream on the bits coded by the first outer code and interleaved constituting an a priori information item, so as to generate a first extrinsic information stream on the bits coded by the first outer code and interleaved;

[[-]]   in subjecting said first extrinsic information stream to a deinterleaving so as to generate a second extrinsic information stream on the coded bits originating from the equalization and joint decoding process;

[[-]]   in subjecting said second extrinsic information stream on the coded bits to a decoding on the basis of said first outer code, so as to generate a third extrinsic information stream on the coded bits, and emanating from the decoding on the basis of said first outer code;

[[-]]   in subjecting said third extrinsic information stream to an interleaving, so as to generate said extrinsic information stream on the bits coded by the first outer code and interleaved, constituting said a priori information item;

[[-]]   in reinjecting said a priori information item into the iterative process for equalization of the transmission channel and joint decoding.

Claim 6 (currently amended): ~~Method according to~~ The method of Claim 5, wherein, for a second inner coding of the spatio-temporal trellis coded modulation type, said iterative process of equalization and joint decoding comprises ~~consists~~:

[[-]]   in demultiplexing said extrinsic information stream on the bits coded by the first outer code and interleaved, constituting said a priori information item, as a set of a priori information streams on the bits of user frames subdivided into packets;

[[-]]   in performing an equalization and a joint decoding with soft input/output which are applied to a trellis with a reduced number of states, this trellis being defined as the product of the combined trellises of the spatio-temporal trellis coded modulations and of the elementary-

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memory channels referring thereto, which themselves have a reduced number of states, so as to generate a stream of weighted outputs on the bits of the user frames;

[[-]] in extracting from each stream of weighted outputs on the bits of the user frames said a priori information item on the bits of the user frames, so as to generate an extrinsic information stream on the bits of the user frames;

[[-]] in multiplexing the extrinsic information streams on the bits of the user frames, so as to generate said first extrinsic information stream on the bits coded by the first outer code and interleaved.

Claim 7 (currently amended): Method according to The method of Claim 5, wherein said decoding by means of said first outer code comprises consists:

[[-]] in subjecting said second extrinsic information stream on the coded bits originating from the equalization and joint decoding process to a decoding with weighted input/output by means of said first outer code, so as to generate a stream of weighted outputs representative of an a posteriori information item on the coded bits;

[[-]] in subtracting said second extrinsic information stream from said stream of weighted outputs representative of said a posteriori information item on the coded bits, so as to generate said third extrinsic information stream on the coded bits.

Claim 8 (currently amended): System A system for coding a digital data stream coded by spatio-temporal combinations in multiple transmission and reception, this said system comprising at least:

[[-]] means of outer coding of an initial digital data stream, on the basis of a first code of specified rate, so as to generate a coded digital stream, subdivided into successive blocks;

[[-]] means of blockwise interleaving making it possible, on the basis of said coded digital stream, to generate an interleaved coded digital stream exhibiting temporal diversity;

[[-]] demultiplexer means receiving said interleaved coded digital stream, making it possible to generate a given number [[v]] of elementary interleaved coded digital streams;

[[-]] a plurality of means of inner coding on the basis of at least one second code of specified rate, each means of inner coding receiving one of said elementary interleaved coded

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digital streams, so as to generate a set of elementary digital streams, coded by spatio-temporal combinations comprising ~~and consisting of~~ symbols;

[[-]] a plurality of transmission antennas for each elementary digital stream coded by spatio-temporal combinations comprising ~~and consisting of~~ symbols, a distinct transmission antenna achieving the transmission of an elementary digital stream, the set of said transmission antennas forming a space-diversity array, said system making it possible to generate a set of transmitted elementary digital streams exhibiting spatial and temporal diversity, thereby making it possible, on reception, to perform a decoding of the transmitted elementary digital streams on the basis of a priori information representative of the spatial and temporal diversity.

Claim 9 (currently amended): ~~Coding~~ The coding system ~~according to~~ of Claim 8, wherein, for a second code making it possible to achieve said inner coding comprising ~~consisting of~~ a code of the spatio-temporal trellis coded modulation type, each code being applied to each elementary interleaved coded digital stream, so as to generate a plurality of streams of modulation symbols, ~~the~~ said distinct transmission antennas are arranged in groups of antennas each transmitting a stream of modulation symbols, ~~the~~ said groups of distinct transmission antennas for each type of spatio-temporal trellis coded modulation forming a sub-array of space-diversity antennas.

Claim 10 (currently amended): ~~System~~ A system for decoding a digital data stream coded by spatio-temporal combination in multiple transmission and reception, ~~this~~ said coded digital data stream comprising ~~consisting~~ at least of a set of transmitted elementary digital streams obtained by a first outer coding of an initial digital data stream by means of a first code of specified rate, blockwise interleaving of the coded digital stream emanating from ~~this~~ said first outer coding, temporal demultiplexing of the coded and interleaved digital stream obtained on a specified number [[v]] of demultiplexing pathways, ~~this~~ said coded and interleaved digital stream being thus subdivided into one and the same specified number [[v]] of elementary coded and interleaved digital streams, subjecting each elementary coded and interleaved digital stream to a second inner coding by means of at least one second code of specified rate so as to generate ~~this~~ said set of elementary digital streams, coded by spatio-

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temporal combinations, transmission of each elementary digital stream subdivided into symbols by means of a distinct transmission antenna according to a set of elementary streams transmitted over a transmission channel, the set of the transmission antennas forming an array of space-diversity transmission antennas, ~~this~~ said decoding system comprising:

[[-]]   a plurality of reception antennas making it possible to receive said set of elementary digital streams transmitted over ~~this~~ said transmission channel, the number of said reception antennas being independent of the number [[v]] of transmission antennas and forming an array of space-diversity reception antennas, so as to define a set of elementary streams of modulation symbols received;

[[-]]   means of turbo-detection of said elementary streams of modulation symbols received by iterative equalization and iterative joint detection and iterative decoding, said turbo-detection means comprising:

[[•]]   means of equalization of the transmission channel and of joint decoding, by means of said second inner coding on the basis of an extrinsic information stream on the bits coded by the first outer code and interleaved and which arises from a decoding on the basis of said outer code, said extrinsic information stream on said bits coded by the first outer code and interleaved constituting an a priori information item, said means of equalization of the transmission channel and of joint decoding making it possible, on the basis of said elementary streams of modulation symbols received, to generate a first extrinsic information stream on the bits coded by the first outer code and interleaved;

[[•]]   means of deinterleaving said first extrinsic information stream, so as to generate a second extrinsic information stream on the coded bits originating from the means of equalization and of joint decoding;

[[•]]   means of decoding on the basis of said first outer code receiving said second extrinsic information stream and making it possible to generate a third extrinsic information stream on the coded bits, which arises from the decoding on the basis of said first outer code;

[[•]]   means of interleaving said third extrinsic information stream, so as to generate said extrinsic information stream on the bits coded by the first outer code and interleaved, constituting said a priori information item reinjected into said means of equalization of the transmission channel and of joint decoding.

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Claim 11 (currently amended): ~~System according to~~ The system of Claim 10, wherein said means of equalization and of joint decoding comprise:

[[-]]   a module for injecting said a priori information item comprising demultiplexer means receiving said a priori information item constituted by said extrinsic information stream on the bits coded by the first outer code and interleaved and delivering a set of a priori information streams on the bits of user frames, said set of streams being demultiplexed on one and the same number [[v]] of demultiplexing pathways as the number of elementary coded and interleaved digital streams generated on transmission;

[[-]]   means of decoding with weighted input/output receiving as input, on the one hand, said a priori information stream on the bits of user frames, and, on the other hand, said elementary streams of modulation symbols received and delivering a stream of weighted outputs on the bits of the user frames;

[[-]]   a plurality of subtractor means, making it possible to subtract from each stream of weighted outputs on the bits of the user frames, said a priori information item on the bits of user frames and delivering an extrinsic information stream on the bits of the user frames;

[[-]]   multiplexer means for multiplexing the extrinsic information streams making it possible, on the basis of said extrinsic information stream on the bits of the user frames, to deliver said first extrinsic information stream on the bits coded by the first code and interleaved.

Claim 12 (currently amended):   ~~System according to~~ The system of Claim 10, wherein said means of decoding on the basis of said first outer code comprise:

[[-]]   a decoding module with weighted input/output receiving said second extrinsic information stream on the coded bits originating from the equalization and joint decoding process and delivering a stream of weighted outputs representative of an a posteriori information item on the coded bits;

[[-]]   a subtractor module making it possible to subtract from said stream of weighted outputs representative of an a posteriori information item on the coded bits said second extrinsic information stream and delivering said third extrinsic information stream on the coded bits, which arises from the decoding on the basis of said first outer code.